

BERKELEY • DAVIS • IRVINE • LOS ANGELES • RIVERSIDE • SAN DIEGO • SAN FRANCISCO



SANTA BARBARA • SANTA CRUZ

MATERIALS DEPARTMENT
SCHOOL OF ENGINEERING AND APPLIED SCIENCES
LOS ANGELES, CALIFORNIA 90024
6532 Boelter Hall

December 5, 1975

Revision

TO: Dr. Russell Hill, Airco Temescal, Berkeley
Dr. Erwin Rudy, Oregon Graduate Center, Portland
Mr. Robert A. Beall, U.S. Bureau of Mines, Albany
Dr. Hugh Smith, Industrial Vacuum Engineering, San Mateo
Dr. Troy Barbee, Jr., Stanford University, Stanford
Dr. Larry Kaufmann, Manlabs, Inc., Cambridge
Mr. Michael Field, Metcut Associates, Cincinnati
Dr. Law McCabe, Teledyne Firth Stirling, Pittsburgh
Dr. Hal Brody, University of Pittsburgh, Pittsburgh
Dr. Richard Heckel, Carnegie-Mellon University, Pittsburgh

RE: Soviet Visitors

Gentlemen:

As I had informed some of you, the visit of the Soviet delegation was postponed by one week. For least confusion, we have inverted the order of their visits between the East and West Coasts. The order and dates for visits to the East Coast- Cambridge, Cincinnati, Pittsburgh remain the same and on the same dates. The order and dates of visits on the West Coast are somewhat modified- Los Angeles-San Francisco-Portland and directly to New York. The revised schedule is attached.

Again, my sincere thanks for all your efforts.

Sincerely yours,

R. F. Bunshah, Chairman
Task Force on Electron Beam Evaporation

RFB:dd
Enclosure

cc: N. Promisel,
R. Wasilewski,
W. Root
E. VanEcho
A. Sheldon

State Dept. declassification & release instructions on file

Electron Beam Evaporation

REVISED ITENARY FOR VISIT OF USSR DELEGATION - TASK FORCE ELECTRON BEAM
EVAPORATION

Visitors are: Prof. B.A. Movchan, Dr. A.V. Demchishin, Dr. L.V. Kovalchuk, Paton Welding Institute, Kiev; Dr. V.N. Andreev, All Union Scientific Research Instrumental Institute; and Mr. S.N. Glebov, State Committee on Science and Technology. Airline reservations have been made and confirmed for flights in the U.S. We expect that Mr. Alexis B. Tatischeff will act as interpreter for the U.S. side and accompany the visitors during their entire visit.

December 7, Sunday : Arrival by Aeroflot 313 from Moscow 6:30 pm.
Holiday Inn-LaGuardia Airport area. Alex
Tatischeff will meet the flight.

December 8, Monday: New York (La Guardia) - Boston AA384
Leave 8:30 am, arrive 9:23 am
Visit Manlabs, Dr. Larry Kaufmann will
pick up at airport. 21 Erie Street,
Cambridge, Mass. 02139 (617) 491-2900.

Boston-Cincinnati, American 453
Leave 5:40 pm, Arrive 8:45 pm.
Proceed by taxi to Quality Inn Central,
4147 Montgomery, Norwood, Ohio

December 9, Tuesday Visit Metcut Research Associates.
Picked up at hotel by Dr. Michael Field,
3980 Rosslyn Drive, Cincinnati, Ohio 45909,
(513) 271-5100

Cincinnati-Pittsburgh, TWA 532
Leave 1 pm, Arrive 1:50 pm
Proceed to Webster Hall Hotel.
Dr. Laughlin will meet party on arrival.

December 10, Wednesday Visit Carnegie Mellon University, Dr. Dick
Heckel and Dr. Lloyd Bauer, Schenley Park,
Pittsburgh, PA 15213, (412) 828-5023.

December 11, Thursday Visit Teledyne Firth Stirling, Dr. Law McCabe,
4 Parkway Center, Pittsburgh, PA 15220
(412) 922-9602

December 12, Friday University of Pittsburgh, Dr. Hal Brody and
Dr. G.H. Meier, 848 Benedum Hall, Pittsburgh,
PA 15213 (412) 624-5302.

December 13, Saturday Pittsburgh-Los Angeles, TWA 53
Leave 6:30 pm, Arrive 8:34 pm
Dr. Bunshah will meet the Flight.
Hotel Claremont, West Los Angeles

December 14, Sunday

Rest in Los Angeles

December 15, Monday

Visit Prof. Bunshah at UCLA, 6532 Boelter Hall, Los Angeles, CA 90024, (213) 825-2210 office, (213) 398-6506 home

December 16, Tuesday

Los Angeles-San Francisco, United 506
Leave 9 am, Arrive 10 am. Hilton Inn, San Francisco Airport.
Visit Airco Temescal, Dr. Russel Hill 2850 Seventh, Berkeley, California (415) 841-5720

December 17, Wednesday

Picked up by Dr. Troy Barbee
(1) Visit Industrial Vacuum Engineering, Dr. Hugh Smith, 307 North Amphlett Blvd., San Mateo, CA 94401 (415) 348-2866.
(2) Visit Stanford University, Center for Materials Research, Stanford, CA 94305
Dr. Troy Barbee, Jr. (415) 497-2300 x 4118
(3) Dinner with Dr. Charles Hunt

December 18, Thursday

San Francisco-Portland, United 482
Leave 8:15 am, Arrive 9:45 am
Dr. Erwin Rudy will meet the plane.
Visit Dr. Erwin Rudy, Oregon Graduate Center, 19600 N.W. Wilke Road, Beaverton, Ore. 97005 (503) 645-1121.
Possibly U.S. Bureau of Mines
Hotel Mendel, Portland

December 19, Friday

Portland-New York (Kennedy), United 40
Leave 7:20 am, Arrive 4:40 pm
Connect to Aeroflot to Moscow

WORKING PLAN

for US-USSR scientific-technical collaboration on the theme "Solid State Joining"

(01.0306)

| ORGANIZATIONS FROM | | | | Forms of | | | |
|--------------------|---|---|---|----------|---|------------|-----|
| 1 | 2 | 3 | 4 | US | 5 | 6 | 7 |
| USSR | | | | | | Start | End |
| | | | | | | Completion | |

1. DIFFUSION WELDING

I. State of the art review of solid state joining of similar and dissimilar metals and alloys in USA and USSR.

1. Review and analysis of theories and hypotheses of the mechanism of joint formation in the diffusion joining of metals.

2. Review of the developments, applications, methods of intensification and apparatus of diffusion joining of similar and dissimilar metals in the US and USSR.

(a) US to review US work and literature

(b) USSR to review USSR work and literature

(c) review paper to be formed by combined surveys of US and USSR work and writing with a joint introduction and summary.

M.Kh.Shorshorov
Baikov Institute
of Metallurgy

W.A.Owczarski
Pratt & Whitney
Aircraft
Div., United
Technologies
Corp.

Nov. 1975

Dec. 1977

A single author jointly with author of paper

M.Kh.Shorshorov
and E.S.
Karakozov

Metallurgy Evening
Institute,
N.F.Kazakov

(MTIMP) Diffusion
Welding
Laboratory

"

Nov. 1975

Dec. 1976

A combined review paper

II. Development of techniques and methods for intensifying the joining of similar and dissimilar metals and alloys, in particular powders, by hot isostatic compaction.

1. Investigation of the effect of load dynamics on intensification of the solid state joining of nickel

2. Investigation of effect of cyclic pressure on intensification of processes for joining nickel and titanium by quasi-static and dynamic loading.

3. Investigation of optimal conditions for joining titanium and its alloys by superplasticity.

M.Kh..Shorshorov
Baikov Institute
of Metallurgy,
Moscow

None

Nov. 1975

Dec. 1976

A paper and specimens

M.Kh.Shorshorov
Baikov Institute
of Metallurgy,
Moscow

None

June 1976

Oct. 1977

A paper and specimens

M.Kh.Shorshorov,
A.S.Tikhonov,
Baikov Institute
of Metallurgy,

None

"

"

"

| | 3 | 4 | 5 | 6 | 7 | 8 |
|----|--|---|---------------------------|-----------|-----------|-----------------------------------|
| 4. | Development of techniques and methods to intensify processes of diffusion joining similar metals and dissimilar alloys, in particular, in combined processes of sintering and welding and use of ultrasonic oscillations (Ni to Ni, Al to Ti, Ti to Ti using Ni, Fe and Ti powders at the joint interfaces). | N.F. Kazakov, A.V. Sergeev, V.A. Bachin. Diffusion Welding Laboratory, Moscow | None | Nov. 1975 | Dec. 1977 | A paper and exchange of specimens |
| 5. | Investigation of the initial structure and loading effect on the process of a joint formation (Ni and Ti alloys). | E.S. Karakozov, A.P. Ternovskij, B.A. Molchanov Metallurgy Evening Institute, Moscow | None | " | " | " |
| 6. | To carry out methods to intensify welding by controlling welding parameters and structure changes in the welding zone (Ni and Ti alloys). | " | None | " | " | " |
| 7. | To carry out effective ways of control of quality of welded joints. | " | None | " | " | " |
| 8. | Investigation of the effect of the ways of surface preparation and the initial structure on the formation of the contact zone structure and properties of joints such as Ni with Ni, Ni-Cr alloy with Ni-Cr alloy (USSR), Co-alloy with stainless steel and Ni-alloy with W (US). Bond strengths will be determined. | L.I. Markashova, J.B. Malevsky | A.T. Male Westinghouse | Nov. 1975 | Dec. 1977 | A paper and exchange of specimens |

Approved For Release 2001/08/27 : CIA-RDP79-00798A000300000006-2

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|------|---|---|--|---|-----------|-----------|-----------------------|
| | | | | A.T. Male Westinghouse | Nov. 1975 | Dec. 1977 | A paper and specimens |
| 9. | Investigation of intensification methods for use in powder metal consolidation of Ni-base, Co-base, and Ti-base alloys; with associated reference to the effect of initial powder structure on the subsequent properties of the consolidated product. | | None | | | | |
| 10. | Investigation of the method of pressure welding in vacuum using impact loading (for example, joining Ni with Ni, Fe with Nb, and Fe with Fe). | | L.N. Larikov, V.M. Falchenko Institute of Physics of Metals. S.M. Gurevich, G.K. Harchenko Institute of Electro Welding. | None | " | " | " |
| 11. | Investigation of the mechanism to eliminate micro-defects by impulse loading (for example, joining Fe with Fe, Ni with Ni and Fe with Nb). | | " | None | " | " | " |
| 12. | Determination of optimal limits of the deformation rate where abnormally high mass transfer is observed (for example, joining Fe with Fe, Ni with Ni and Fe with Nb). | | " | None | Jan. 1977 | Dec. 1977 | " |
| III. | Investigation of the kinetics of heterodiffusion and formation of intermediate phases during the joining of dissimilar metals and alloys. | | K.P. Gurov Baikov Institute of Metallurgy, Moscow | J.I. Goldstein Lehigh University, USA. | Nov. 1975 | Dec. 1977 | Papers |

| Topic | Author(s) | Date | Location | Notes |
|--|---|-----------|-----------|----------------------------------|
| 2. Analytic investigation of heterodiffusion and growth process of joining dissimilar metals, forming diagrams of the eutectoid type. | K.P.Gurov Baikov Institute of Metallurgy, Moscow | Nov. 1975 | Dec. 1977 | Papers |
| 3. General analytic investigation of heterodiffusion and growth of intermediate phases in the process of joining dissimilar metals by contact melting. | K.P.Gurov, M.Kh.Shorshorov, V.A. Antipov Baikov Inst. of Metallurgy, Ac.Sc., USSR. | June 1976 | Nov. 1977 | " |
| 4. Experimental investigations of heterodiffusion process kinetics and formation of intermediate phases in binary (Fe-Al), (Al-Ti, Ni-Mo-USSR), and ternary systems (Fe-Ni-Al) during the process of diffusion joining (solid state) of dissimilar metals and alloys. Application of analytic and computer methods to this problem. Application of stress field models to the solid state joining process. | L.N.Larikov, V.M.Falchenko, V.M.Tishkevich, N.F.Kazakov, A.V.Sergeev, V.A. Bachin, V.P. Antonov | Nov. 1975 | Dec. 1977 | Papers and exchange of specimens |
| 5. Investigation of the use of various diffusion barriers in the production of composite specimens from the SiC/Ni alloy, SiC/Co alloy (USA) and SiC/Ti alloy specimens. Particular attention to be paid to the attainment of optimum strength properties. | M.Kh.Shorshorov | Nov. 1975 | Dec. 1977 | A Paper |

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|--|---|---|---|---|-----------|-----------|---------------------------------|
| | | 6. Investigation of barrier effect of metallic interlayers on heterodiffusion between Fe-Al with a thin film interlayer of Ag. | L.N.Larikov, V.M.Falchenko, V.M.Tishkevich | J.I.Goldstein, M.R.Notis, P.Hilton Lehigh University, USA. | Nov. 1975 | Dec. 1977 | A paper and exchange of samples |
| IV. Mathematical simulation and calculation of the processes of formation of joints between dissimilar metals and alloys with emphasis on intermediate phases formation. | | 1. Mathematical simulation of the formation stages for the physical contact and activation of contact surfaces in the process of joining dissimilar materials of strongly differing in resistance to deformation. | M.Kh.Shorshorov, V.P.Alekhin, Baikov Inst. of Metallurgy, Moscow | None | Oct. 1976 | Nov. 1977 | Papers |
| | | 2. Mathematical simulation of the growth of intermediate phases by heterodiffusion in the process of joining, and comparison to experimental data on systems such as the joining of Al to Ni. | K.P.Gurov, M.Kh.Shorshorov, V.I.Antipov A.F.Shelest | R.W.Heckel, R.F.Sekerka, C.L.Bauer Carnegie-Mellon University, USA | Nov. 1975 | Dec. 1977 | " |
| | | 3. To carry out a statistical model of physical contact formation by diffusion welding and matching of contact surfaces of similar metals and alloys. | E.S.Karakozov, J.V.Mjakishev, A.P.Ternovskij, B.A.Molchanov Metallurgy Evening Institute, Moscow. | None | " | " | " |
| | | 4. To carry out models for welding pressure due to thermal stresses, forming as a result of difference in coefficients of thermal expansion of materials being joined and devices. | " | None | " | " | " |
| | | 5. Mathematical simulation and calculation of processes of formation of a diffusion joint between dissimilar metals and alloys and intermediate phases. (Ni with Ni, Ni with Ti, and Al with Ti) | N.F.Kazakov, S.N.Golov Diffusion Welding Laboratory, Moscow | None | Nov. 1975 | Dec. 1977 | Papers |

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|--|---|--|---|--|--------------|--------------|---------|
| | | 6. To develop quantitative models to describe the variation of stresses near an interface. Effects of thermal stresses and diffusion processes will be considered. Bulk specimens and thin film couples will be used to make experimental measurements (Fe-Ni-Al). | None | P.Hilton, M.R.Notis Lehigh University, USA. | Nov. 1975 | Dec. 1977 | Paper |
| 2. COMPOSITE MATERIALS | | | | | | | |
| I. Investigation of the effects of residual stresses on the mechanical behavior of composites. | | | | | | | |
| | | 1. Investigation on models by means of holography of the stress field at the tip of a crack propagating from a barrier coating into a fibre taking into account residual stresses in the components of composite materials. | M.Kh.Shorshorov, L.M.Ustinov, V.V.Belov, Baikov Inst. of Metallurgy, Moscow | None | Nov. 1976 | Nov. 1977 | Paper |
| | | 2. Investigation of the development of residual stresses and their effect on strength of composite materials such as Al-B and Ni-W as a result of diffusional degradation (US) and such as Al-B, Al-stainless steel in the process of thermal cycling (USSR). | M.Kh.Shorshorov, L.M.Ustinov, V.V.Belov | R.W.Heckel Carnegie-Mellon University, USA | Nov. 1975 | Dec. 1977 | " |
| | | 3. Investigation of residual stress effect on the mechanical properties of composite materials by diffusion welding (Cu and Mo, Cu and W, Al and Ti). | N.F.Kazakov, A.V.Sergeev, V.A.Bachin Diffusion Welding Laboratory, Moscow | None | Jan. 1976 | Dec. 1977 | A Paper |

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|-----|---|---|---|---|-----------|-----------|--------|
| | 4. Development of mathematical models for residual stress effects relating to the mechanical behavior of composites. | | None | L.J.Ebert Case-Western University USA | Nov. 1975 | Dec. 1977 | Papers |
| II. | Application of acoustic emission to the study of deformation and fracture of composites. | 1. To carry out a dislocation model of acoustic emission to determine analytical dependence of AE parameters on the deformation parameters using data of tensile tests for monocrystals of B.C.C. metals and amplitude--frequency analysis of AE signals. | M.Kh.Shorshorov, O.V.Gusev Baikov Inst. of Metallurgy, Moscow | None | Nov. 1975 | Nov. 1976 | " |
| | 2. Investigation by means of AE of detailed mechanisms of deformation and fracture for composite materials (aluminum-boron fibres and steel wire - (USSR)) and (aluminum reinforced with stainless steel wire - (USA)). | | " | G.R.Speich U.S.Steel Research Laboratory | Nov. 1975 | Dec. 1977 | " |

Head of the theme "Solid State Joining" from the Soviet side

Prof., Dr.

M. Kh. Shorshorov

Head of the theme "Solid State Joining" from the USA side

Prof., Dr.

R.W. Heckel

November 21, 1975
Moscow

RECEIVED

7

| ORGANIZATIONS FROM | Start | End | Forms of Completion |
|--------------------|-------|-----|---------------------|
| CCD | 112 | | |

THE

11

| Start | End | Completion |
|-------|-----|------------|
| 1 | 2 | 3 |
| 4 | 5 | 6 |
| 7 | 8 | 9 |
| 10 | 11 | 12 |
| 13 | 14 | 15 |
| 16 | 17 | 18 |
| 19 | 20 | 21 |
| 22 | 23 | 24 |
| 25 | 26 | 27 |
| 28 | 29 | 30 |
| 31 | 32 | 33 |
| 34 | 35 | 36 |
| 37 | 38 | 39 |
| 40 | 41 | 42 |
| 43 | 44 | 45 |
| 46 | 47 | 48 |
| 49 | 50 | 51 |
| 52 | 53 | 54 |
| 55 | 56 | 57 |
| 58 | 59 | 60 |
| 61 | 62 | 63 |
| 64 | 65 | 66 |
| 67 | 68 | 69 |
| 70 | 71 | 72 |
| 73 | 74 | 75 |
| 76 | 77 | 78 |
| 79 | 80 | 81 |
| 82 | 83 | 84 |
| 85 | 86 | 87 |
| 88 | 89 | 90 |
| 91 | 92 | 93 |
| 94 | 95 | 96 |
| 97 | 98 | 99 |
| 100 | 101 | 102 |
| 103 | 104 | 105 |
| 106 | 107 | 108 |
| 109 | 110 | 111 |
| 112 | 113 | 114 |
| 115 | 116 | 117 |
| 118 | 119 | 120 |
| 121 | 122 | 123 |
| 124 | 125 | 126 |
| 127 | 128 | 129 |
| 130 | 131 | 132 |
| 133 | 134 | 135 |
| 136 | 137 | 138 |
| 139 | 140 | 141 |
| 142 | 143 | 144 |
| 145 | 146 | 147 |
| 148 | 149 | 150 |
| 151 | 152 | 153 |
| 154 | 155 | 156 |
| 157 | 158 | 159 |
| 160 | 161 | 162 |
| 163 | 164 | 165 |
| 166 | 167 | 168 |
| 169 | 170 | 171 |
| 172 | 173 | 174 |
| 175 | 176 | 177 |
| 178 | 179 | 180 |
| 181 | 182 | 183 |
| 184 | 185 | 186 |
| 187 | 188 | 189 |
| 190 | 191 | 192 |
| 193 | 194 | 195 |
| 196 | 197 | 198 |
| 199 | 200 | 201 |
| 202 | 203 | 204 |
| 205 | 206 | 207 |
| 208 | 209 | 210 |
| 211 | 212 | 213 |
| 214 | 215 | 216 |
| 217 | 218 | 219 |
| 220 | 221 | 222 |
| 223 | 224 | 225 |
| 226 | 227 | 228 |
| 229 | 230 | 231 |
| 232 | 233 | 234 |
| 235 | 236 | 237 |
| 238 | 239 | 240 |
| 241 | 242 | 243 |
| 244 | 245 | 246 |
| 247 | 248 | 249 |
| 250 | 251 | 252 |
| 253 | 254 | 255 |
| 256 | 257 | 258 |
| 259 | 260 | 261 |
| 262 | 263 | 264 |
| 265 | 266 | 267 |
| 268 | 269 | 270 |
| 271 | 272 | 273 |
| 274 | 275 | 276 |
| 277 | 278 | 279 |
| 280 | 281 | 282 |
| 283 | 284 | 285 |
| 286 | 287 | 288 |
| 289 | 290 | 291 |
| 292 | 293 | 294 |
| 295 | 296 | 297 |
| 298 | 299 | 300 |
| 301 | 302 | 303 |
| 304 | 305 | 306 |
| 307 | 308 | 309 |
| 310 | 311 | 312 |
| 313 | 314 | 315 |
| 316 | 317 | 318 |
| 319 | 320 | 321 |
| 322 | 323 | 324 |
| 325 | 326 | 327 |
| 328 | 329 | 330 |
| 331 | 332 | 333 |
| 334 | 335 | 336 |
| 337 | 338 | 339 |
| 340 | 341 | 342 |
| 343 | 344 | 345 |
| 346 | 347 | 348 |
| 349 | 350 | 351 |
| 352 | 353 | 354 |
| 355 | 356 | 357 |
| 358 | 359 | 360 |
| 361 | 362 | 363 |
| 364 | 365 | 366 |
| 367 | | |

21

د

4

୩

②

4

3

1. DIFFUSION WELDING

I. State of the art review
2- of solid state joining
9- of similar and dissimi-
00- lar metals and alloys
00- on USA and USSR.

1. Review and analysis of theories and hypotheses of the mechanism of joint formation in the diffusion joining of metals.

| | | | | |
|------------------|---------------|------|------|----------|
| M.Kh.Shoshorov | W.A.Omczarski | Nov. | Dec. | A single |
| Baikov Institute | Pratt & Whit- | 1975 | 1977 | jointly |
| of Metallurgy | ney Aircraft | | | authored |

| | | | |
|---------------------------------|------|------|----------------|
| W.A. Owczarski | Nov. | Dec. | A single |
| Pratt & Whitney Aircraft | 1975 | 1977 | jointly |
| Div., United Technologies Corp. | | | authored paper |

2. Review of the developments, applications, methods of intensification and apparatus of diffusion joining of similar and dissimilar metals in the US and USSR.

| | | | | |
|---|---|-----------|-----------|-------------------------------|
| M.Kh. Shorshorov and E.S. Karakozov | " | Nov. 1975 | Dec. 1976 | A combined review paper |
| Metalurgy Ev- ening Institute, N.F. Kazakov (MTIMP) Diffu- sion Welding Laboratory | | | | |

- (a) US to review US work and literature
- (b) USSR to review USSR work and literature
- (c) review paper to be formed by combined surveys of US and USSR work and writing with a joint introduction and summary.

| | | | | | |
|---|--|------|-----------|-----------|-----------------------|
| 1. Investigation of the effect of load dynamics on intensification of the solid state joining of nickel | M.Kh. Shorshorov Baikov Institute of Metallurgy, Moscow | None | Nov. 1975 | Dec. 1976 | A paper and specimens |
|---|--|------|-----------|-----------|-----------------------|

| | | | | |
|--|--|-----------|-----------|-----------------------|
| 2. Investigation of effect of cyclic pressure on intensification of processes for joining nickel and titanium by quasi-static and dynamic loading. | None | June 1976 | Oct. 1977 | A paper and specimens |
| | M.Kh. Shorshorov Baikov Institute of Metallurgy, Moscow | | | |

3. Investigation of optimal conditions for joining titanium and its alloys by superplasticity.

M.Kh. Shorshorov,
A.S. Tikhonov,
Baikov Institute
of Metallurgy,

None

22

11

11

UNCLASSIFIED

Electrometallurgy

UNCLASSIFIED

1 2 3 4 5 6 7 8

| | | | | | |
|---|---|-------------------------------|-----------|-----------|-----------------------------------|
| 4. Development of techniques and methods to intensify processes of diffusion joining similar metals and dissimilar alloys, in particular, in combined processes of sintering and welding and use of ultrasonic oscillations (Ni to Ni, Al to Ti, Ti to Ti using Ni, Fe and Ti powders at the joint interfaces). | N.F. Kazakov, A.V. Sergeev, V.A. Bachin. Diffusion Welding Laboratory, Moscow | None | Nov. 1975 | Dec. 1977 | A paper and specimens |
| 5. Investigation of the initial structure and loading effect on the process of a joint formation (Ni and Ti alloys). | E.S. Karakozov, A.P. Ternovskij, B.A. Molchanov Metallurgy Evening Institute, Moscow | None | " | " | " |
| 6. To carry out methods to intensify welding by controlling welding parameters and structure changes in the welding zone (Ni and Ti alloys). | " | None | " | " | " |
| 7. To carry out effective ways of control of quality of welded joints. | " | None | " | " | " |
| 8. Investigation of the effect of the ways of surface preparation and the initial structure on the formation of the contact zone structure and properties of joints such as Ni with Ni, Ni-Cr alloy with Ni-Cr alloy (USSR), Co-alloy with stainless steel and Ni-alloy with W (US). Bond strengths will be determined. | L.I. Markashova, J.B. Malevsky | A.T. Malevsky Westinghouse | Nov. 1975 | Dec. 1977 | A paper and exchange of specimens |

UNCLASSIFIED

UNCLASSIFIED

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|

9. Investigation of intensification methods for use in powder metal consolidation of Ni-base, Co-base, and Ti-base alloys; with associated reference to the effect of initial powder structure on the subsequent properties of the consolidated product.

10. Investigation of the method of pressure welding in vacuum using impact loading (for example, joining Ni with Ni, Fe with Nb, and Fe with Fe).

None
L.N.Larikov,
V.M.Falchenko
Institute of
Physics of Metals.
S.M.Gurevich,
G.K.Harchenko
Institute of Elec-
tro Welding.

A.T.Male
Westinghouse
Nov. Dec. 1975 1977
A paper and
specimens

11. Investigation of the mechanism to eliminate micro-defects by impulse loading (for example, joining Fe with Fe, Ni with Ni and Fe with Nb).

None

12. Determination of optimal limits of the deformation rate where abnormally high mass transfer is observed (for example, joining Fe with Fe, Ni with Ni and Fe with Nb).

None

Jan. Dec.
1977 1977

III. Investigation of the kinetics of heterodiffusion and formation of intermediate phases during the joining of dissimilar metals and alloys.

1. Development of analytic expressions and computer simulation methods for describing heterodiffusion and growth of intermediate phases in binary and ternary systems.

K.P.Gurov
Baikov Institute
of Metallurgy,
Moscow
J.I.Goldstein
Lehigh Univer-
sity, USA.

Nov. Dec.
1975 1977
Papers

UNCLASSIFIED

UNCLASSIFIED

1 2 3 4 5 6 7 8

2. Analytic investigation of heterodiffusion and growth process of joining dissimilar metals, forming diagrams of the eutectoid type.

Nov. 1975
Dec. 1977
Papers

K.P.Gurov
Baikov Institute
of Metallurgy,
Moscow

None

3. General analytic investigation of heterodiffusion and growth of intermediate phases in the process of joining dissimilar metals by contact melting.

June 1976
Nov. 1977
"

None

K.P.Gurov,
M.Kh.Shorshorov,
V.A. Antipov
Baikov Inst. of
Metallurgy,
Ac.Sc., USSR.

4. Experimental investigations of heterodiffusion process kinetics and formation of intermediate phases in binary (Fe-Al), (Al-Ti, Ni-Mo-USSR), and ternary systems (Fe-Ni-Al) during the process of diffusion joining (solid state) of dissimilar metals and alloys. Application of analytic and computer methods to this problem. Application of stress field models to the solid state joining process.

Nov. 1975
Dec. 1977
Papers and
exchange of
specimens

L.N.Larikov,
V.M.Falchenko,
V.M.Tishkevich,
N.F.Kazakov,
A.V.Sergeev,
V.A. Bachin,
V.P. Antonov
J.I.Goldstein,
M.R.Notis,
P.Hilton
Lehigh University,
USA.

5. Investigation of the use of various diffusion barriers in the production of composite specimens from the SiC/Ni alloy, SiC/Co alloy (USA) and SiC/Ti alloy specimens. Particular attention to be paid to the attainment of optimum strength properties.

Nov. 1975
Dec. 1977
A Paper

M.Kh.Shorshorov
A.T.Male
Westinghouse
Electric, USA.

UNCLASSIFIED

UNCLASSIFIED

5.

Approved For Release 2001/08/27 : CIA-RDP79-00798A000300070006-2

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|
|---|---|---|---|---|---|---|---|

6. Investigation of barrier effect of metallic interlayers on heterodiffusion between Fe-Al with a thin film interlayer of Ag.

J.I. Goldstein, Nov. 1975
M.R. Notis, Dec. 1977
P. Hilton
Lehigh University, USA.

A paper and exchange of samples

IV. Mathematical simulation and calculation of the processes of formation of joints between dissimilar metals and alloys with emphasis on intermediate phases formation.

1. Mathematical simulation of the formation stages for the physical contact and activation of contact surfaces in the process of joining dissimilar materials of strongly differing in resistance to deformation.

M.Kh. Shorshorov, V.P. Alekhin, Baikov Inst. of Metallurgy, Moscow

Oct. 1976
Nov. 1977

Papers

2. Mathematical simulation of the growth of intermediate phases by heterodiffusion in the process of joining, and comparison to experimental data on systems such as the joining of Al to Ni.

K.P. Gurov, M.Kh. Shorshorov, V.I. Antipov
A.F. Shelest

Nov. 1975
Dec. 1977

"

3. To carry out a statistical model of physical contact formation by diffusion welding and matching of contact surfaces of similar metals and alloys.

E.S. Karakozov, J.V. Mjakishev, A.P. Ternovskij, B.A. Molchanov
Metallurgy Evening Institute, Moscow.

"

4. To carry out models for welding pressure due to thermal stresses, forming as a result of difference in coefficients of thermal expansion of materials being joined and devices.

None

"

5. Mathematical simulation and calculation of processes of formation of a diffusion joint between dissimilar metals and alloys and intermediate phases. (Ni with Ni, Ni with Ti, and Al with Ti)

N.F. Kazakov, S.N. Golov
Diffusion Welding Laboratory, Moscow

Nov. 1975
Dec. 1977

Papers

Approved For Release 2001/08/27 : CIA-RDP79-00798A000300070006-2

UNCLASSIFIED

UNCLASSIFIED

6.

Approved For Release 2001/08/27 : CIA-RDP79-00798A000300070006-2

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|

6. To develop quantitative models to describe the variation of stresses near an interface. Effects of thermal stresses and diffusion processes will be considered. Bulk specimens and thin film couples will be used to make experimental measurements (Fe-Ni-Al).

P.Hilton,
M.R.Notis
Lehigh University,
USA.

Nov. 1975
Dec. 1977

Papers

2. COMPOSITE MATERIALS

1. Investigation of the effects of residual stresses on the mechanical behavior of composites.

1. Investigation on models by means of holography of the stress field at the tip of a crack propagating from a barrier coating into a fibre taking into account residual stresses in the components of composite materials.

Nov. 1976
Nov. 1977

Paper

2. Investigation of the development of residual stresses and their effect on strength of composite materials such as Al-B and Ni-W as a result of diffusional degradation (US) and such as Al-B, Al-stainless steel in the process of thermal cycling (USSR).

M.Kh.Shorshorov,
L.M.Ustinov,
V.V.Belov

Nov. 1975
Dec. 1977

"

3. Investigation of residual stress effect on the mechanical properties of composite materials by diffusion welding (Cu and Mo, Cu and W, Al and Ti).

N.F.Kazakov,
A.V.Sergeev,
V.A.Bachin

Jan. 1976
Dec. 1977

A Paper

Approved For Release 2001/08/27 : CIA-RDP79-00798A000300070006-2

UNCLASSIFIED

UNCLASSIFIED

1

2

3

4

5

6

7

8

4. Development of mathematical models for residual stress effects relating to the mechanical behavior of composites.

Application of acoustic emission to the study of deformation and fracture of composites.

1. To carry out a dislocation model of acoustic emission to determine analytical dependence of AE parameters on the deformation parameters using data of tensile tests for monocrystals of B.C.C. metals and amplitude-frequency analysis of AE signals.

2. Investigation by means of AE of detailed mechanisms of deformation and fracture for composite materials (aluminum-boron fibres and steel wire - (USSR)) and (aluminum reinforced with stainless steel wire - (USA)).

G.R.Speich
U.S.Steel
Research
Laboratory

Nov. 1975
Dec. 1977

"

Head of the theme "Solid State Joining" from the Soviet side
Prof., Dr.

M.Kh.Shorshorov

Head of the theme "Solid State Joining" from the USA side
Prof., Dr.

R.W.Heckel

L.J.Ebert
Case-Western
University
USA

Nov. 1975
Dec. 1977

Papers

Nov. 1975
Nov. 1976

None

M.Kh.Shorshorov,
O.V.Gusev
Baikov Inst. of
Metallurgy,
Moscow

UNCLASSIFIED